CHALMERS
UNIVERSITY OF TECHNOLOGY

Indikatorer för utvecklingen av de Europeiska energisystemen

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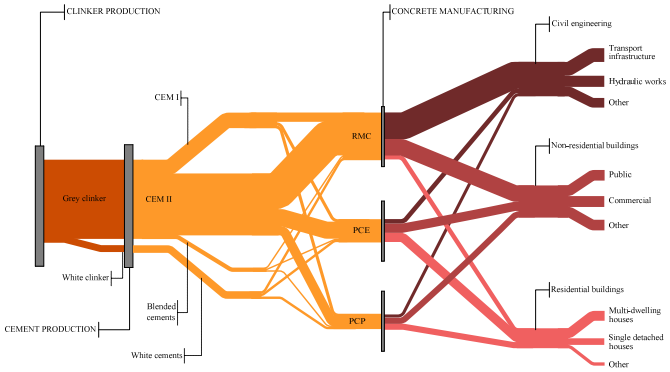
nepp
NORTHERN EUROPEAN ENERGY PERSPECTIVES PROJECT

Indicators (KPI)

- **Environment (CO_2)**

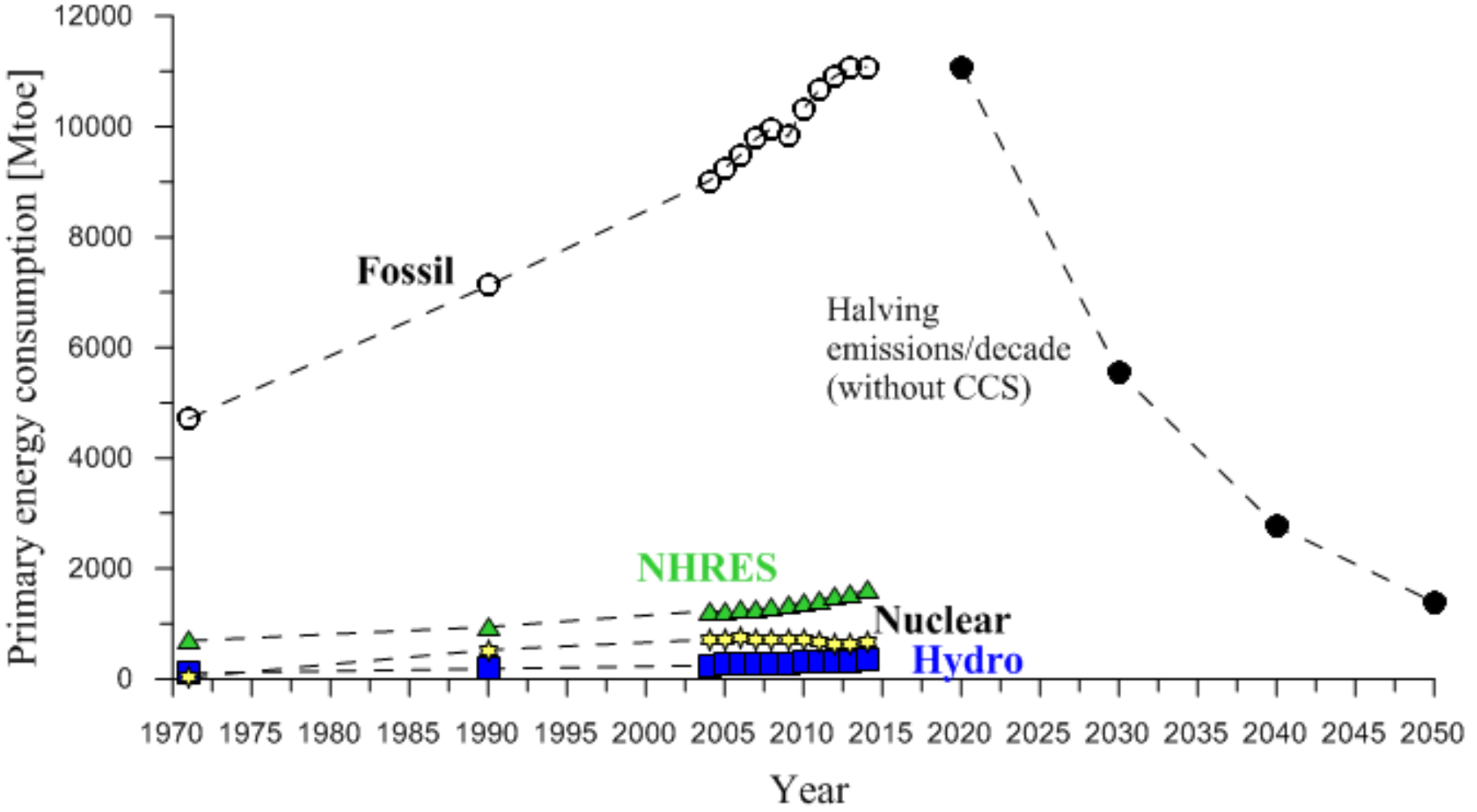
Indicators (KPI)

- Environment (CO_2)
- **Global trends**
  - Example: Fossil-fuel share
- **Economy and Security of Supply**
  - Example: Infrastructure
- **Cross-sectoral integration**
  - Example: hydrogen and value of wind
- **“Green” Pricing - Consumer side**
  - Example: Cement and steel



Global trends – fossil-fuel share

Transformative/disruptive transition required!



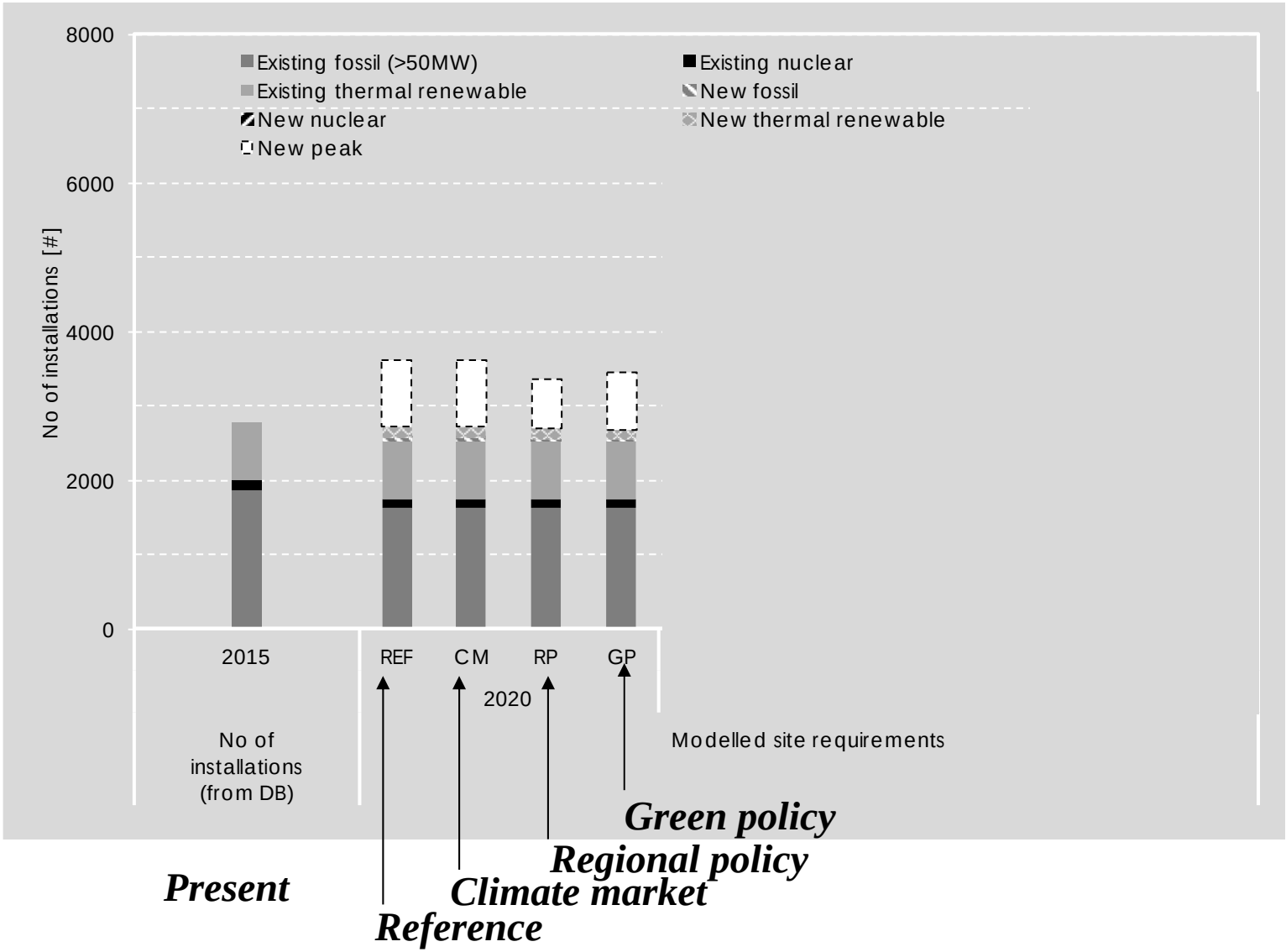
NHRES=Non-hydro renewables

Filled symbols correspond to halving emissions per decade as proposed by Rockström et al., Science, 24 March 2017, Vol 355, Issue 6331
Data from IEA

Johnsson et al. (submitted)

Europe….

Infrastructure - Number of sites for thermal units



Odenberger et al., 2017

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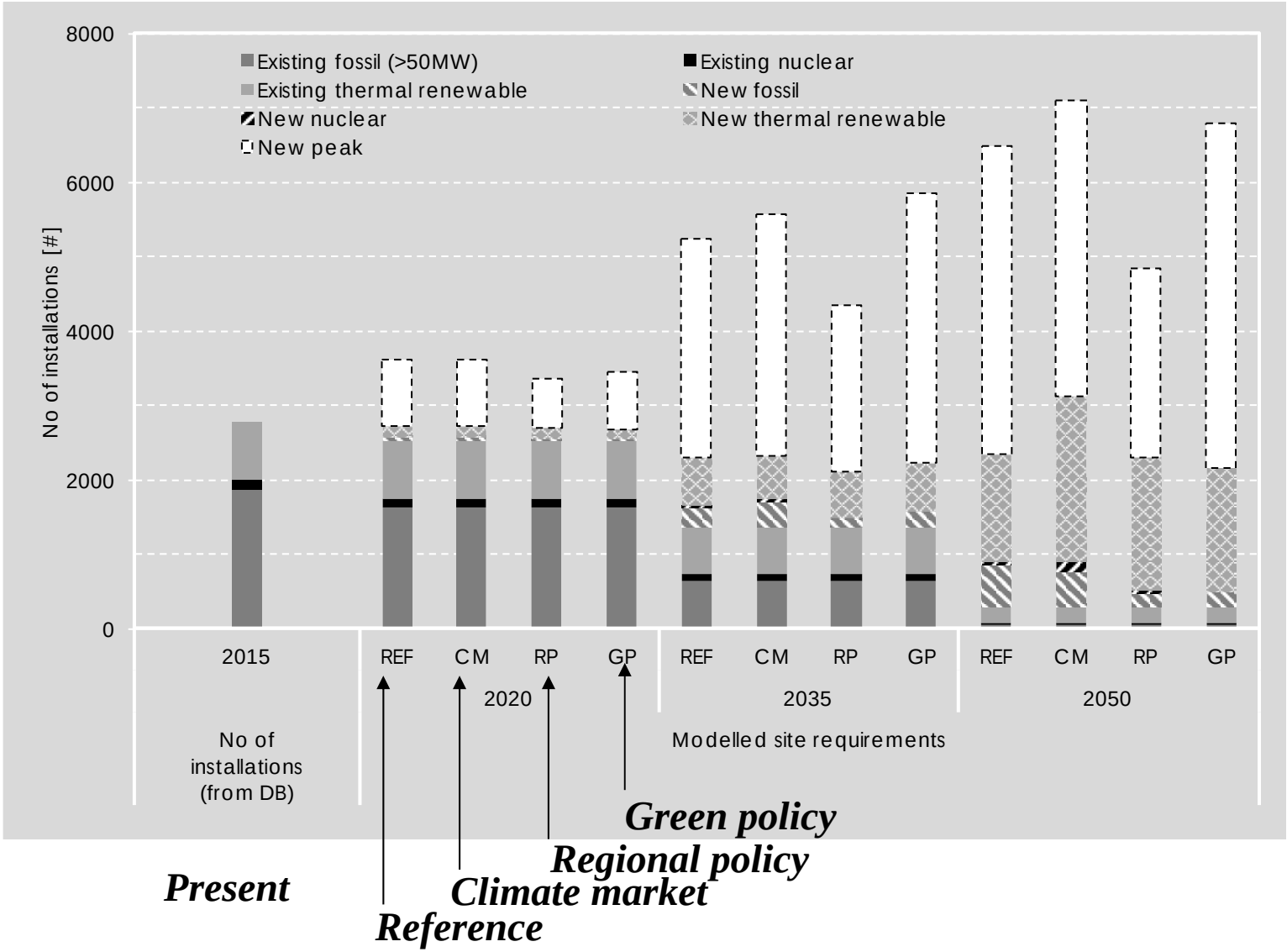

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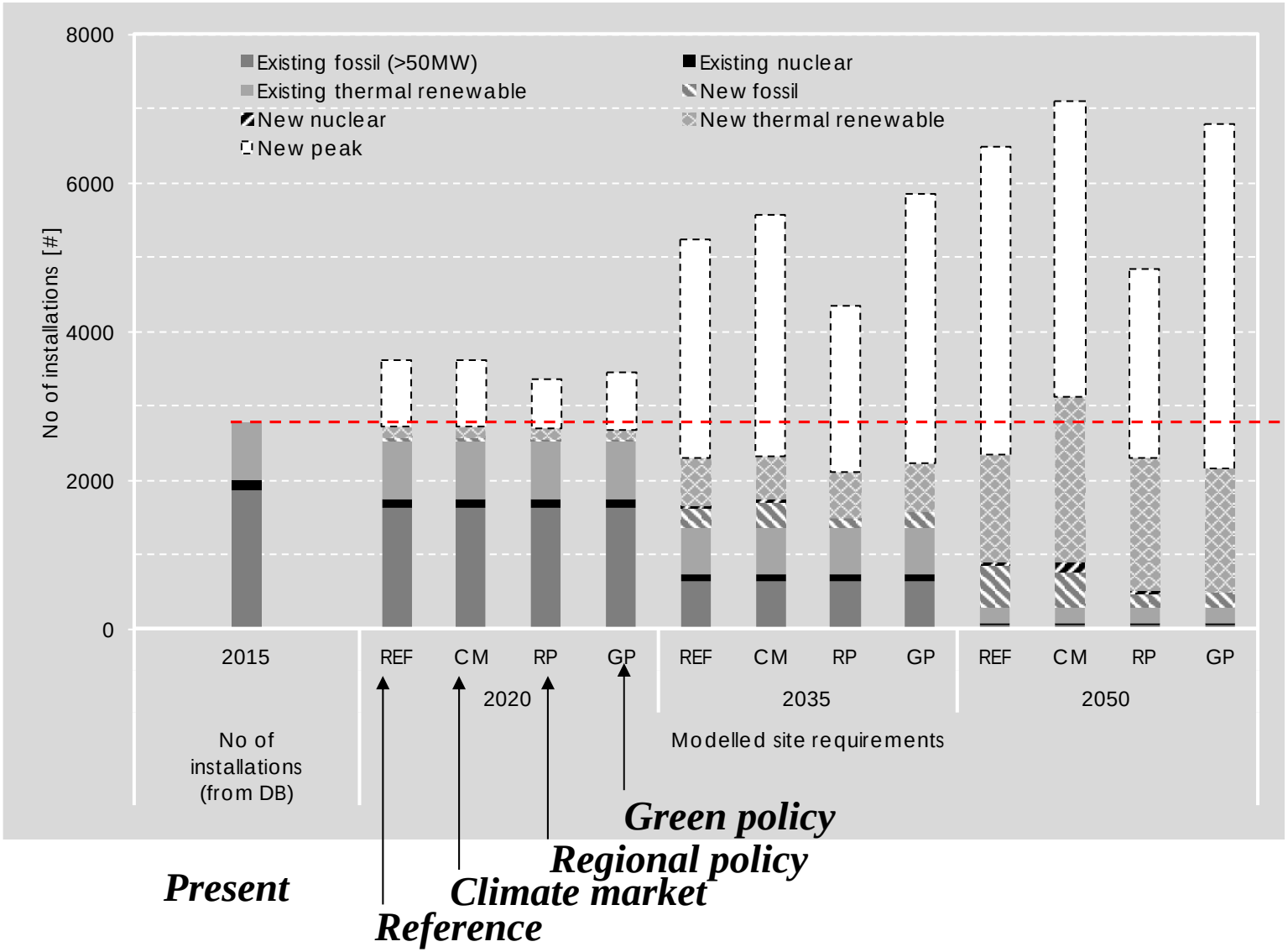

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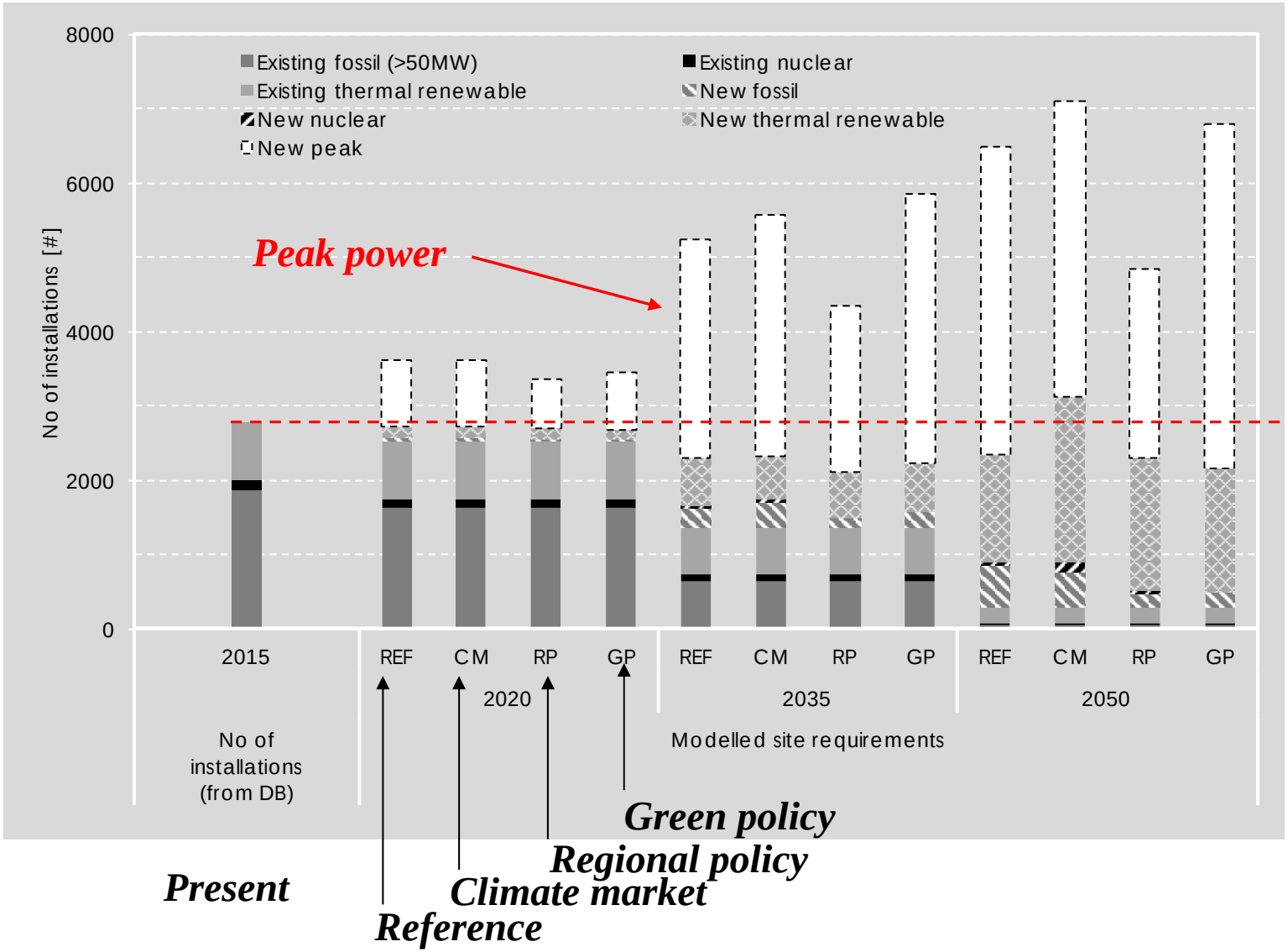
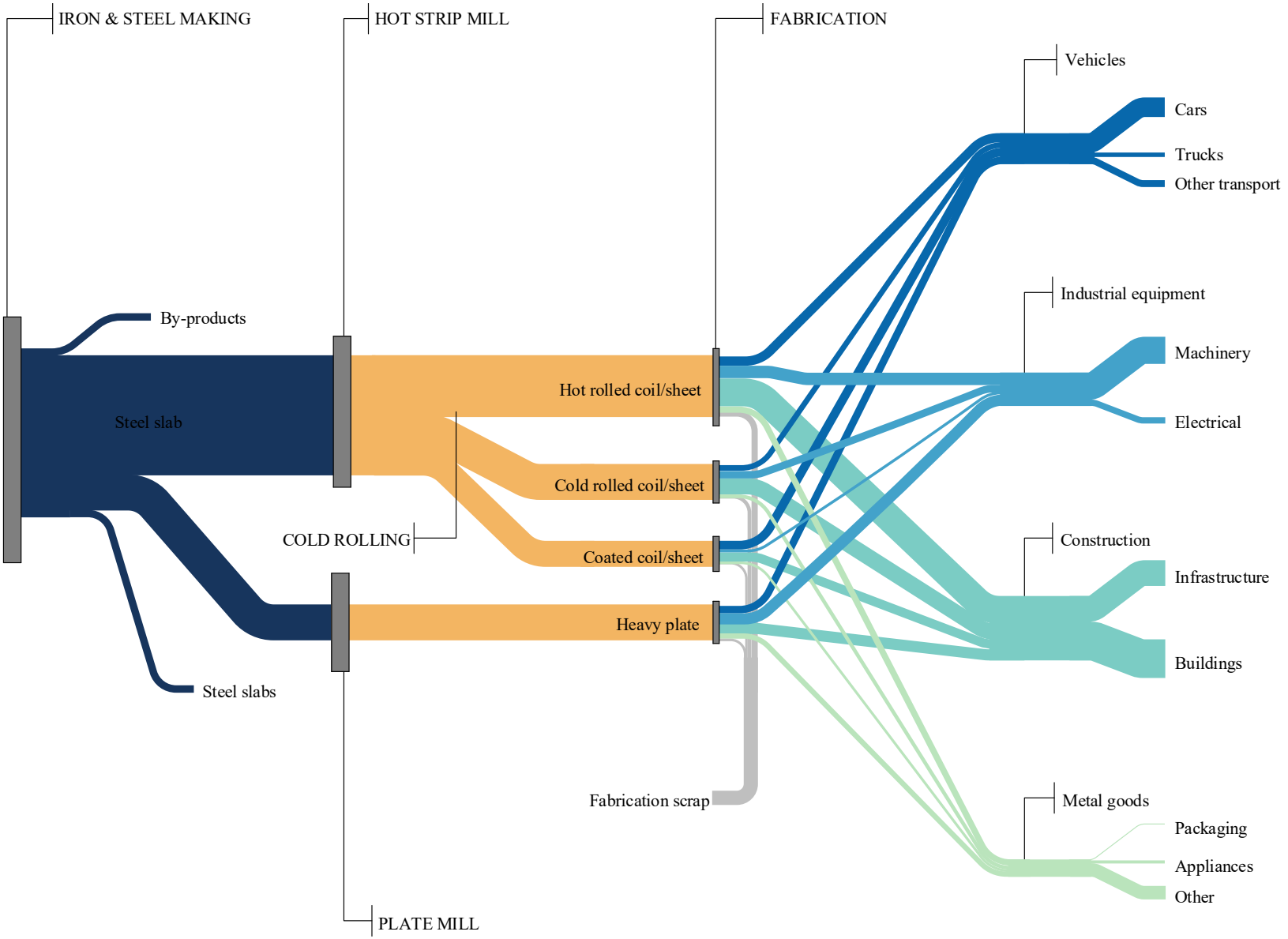


Odenberger et al., 2017

Cross-sectoral integration

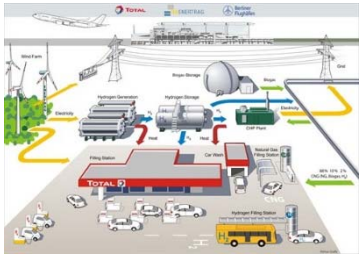


Rootzén and Johnsson (2017)

Cross-sectoral integration

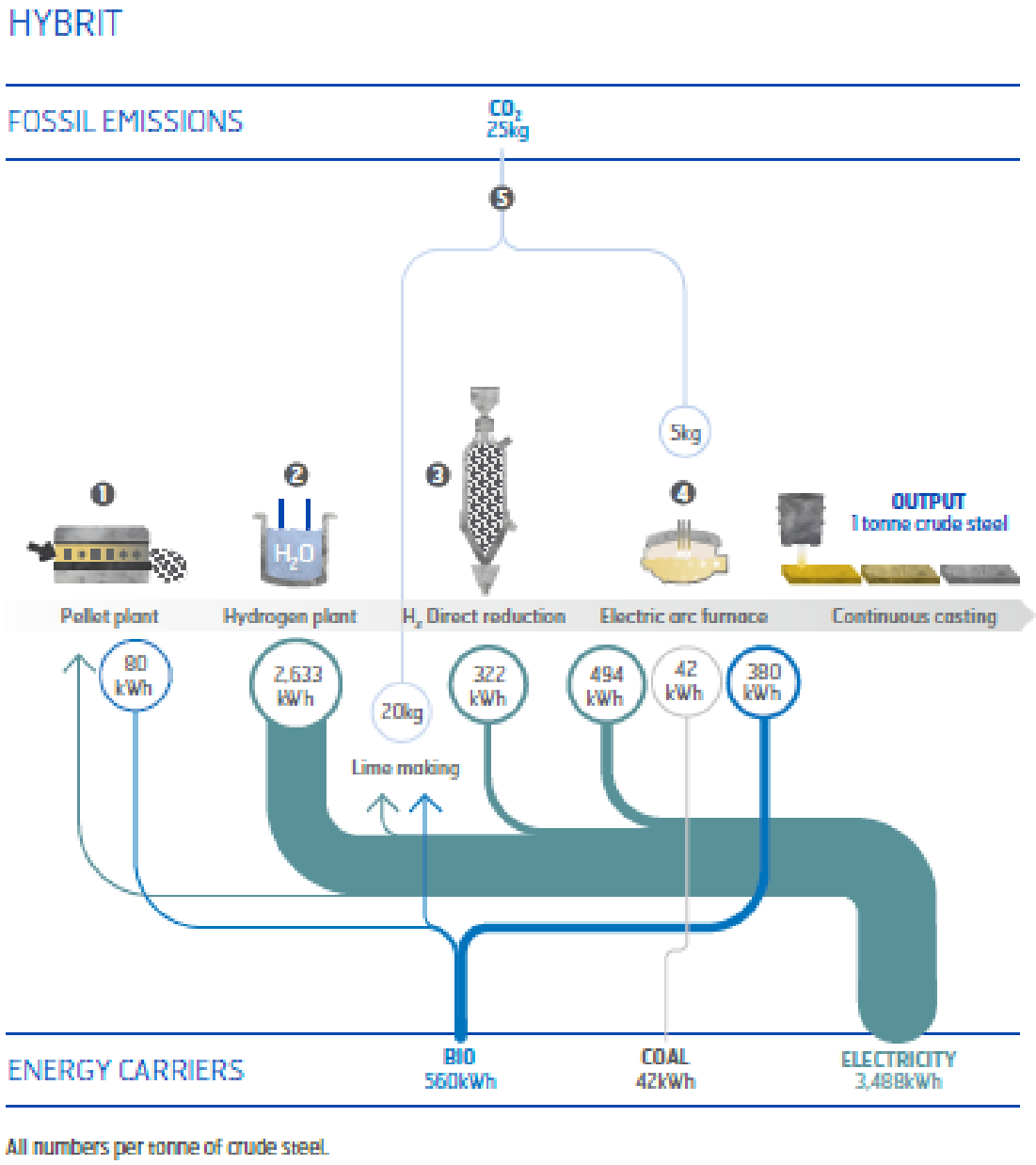
Variation management strategies required for maximizing the value of wind and solar PV

Shifting	Absorbing	Complementing
Electricity ⇒ Electricity • *Reduce curtailment and peak power* • *More even costs on diurnal basis*	***Electricity ⇒ Fuel and heat*** • *Reduce curtailment* • *Fewer low cost events*	***Fuel ⇒ Electricity*** • *Reduce peak power* • *More even costs on yearly basis*
Batteries	**Power-to-heat**	**Flexible thermal generation**
Load shifting	**Electrofuels**	**Reservoir hydropower**
Pumped hydro	**Power to gas (hydrogen)**	



Göransson, L., Johnsson, F. (submitted)

Hydrogen steel making – value of wind



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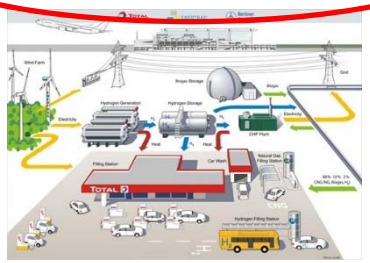
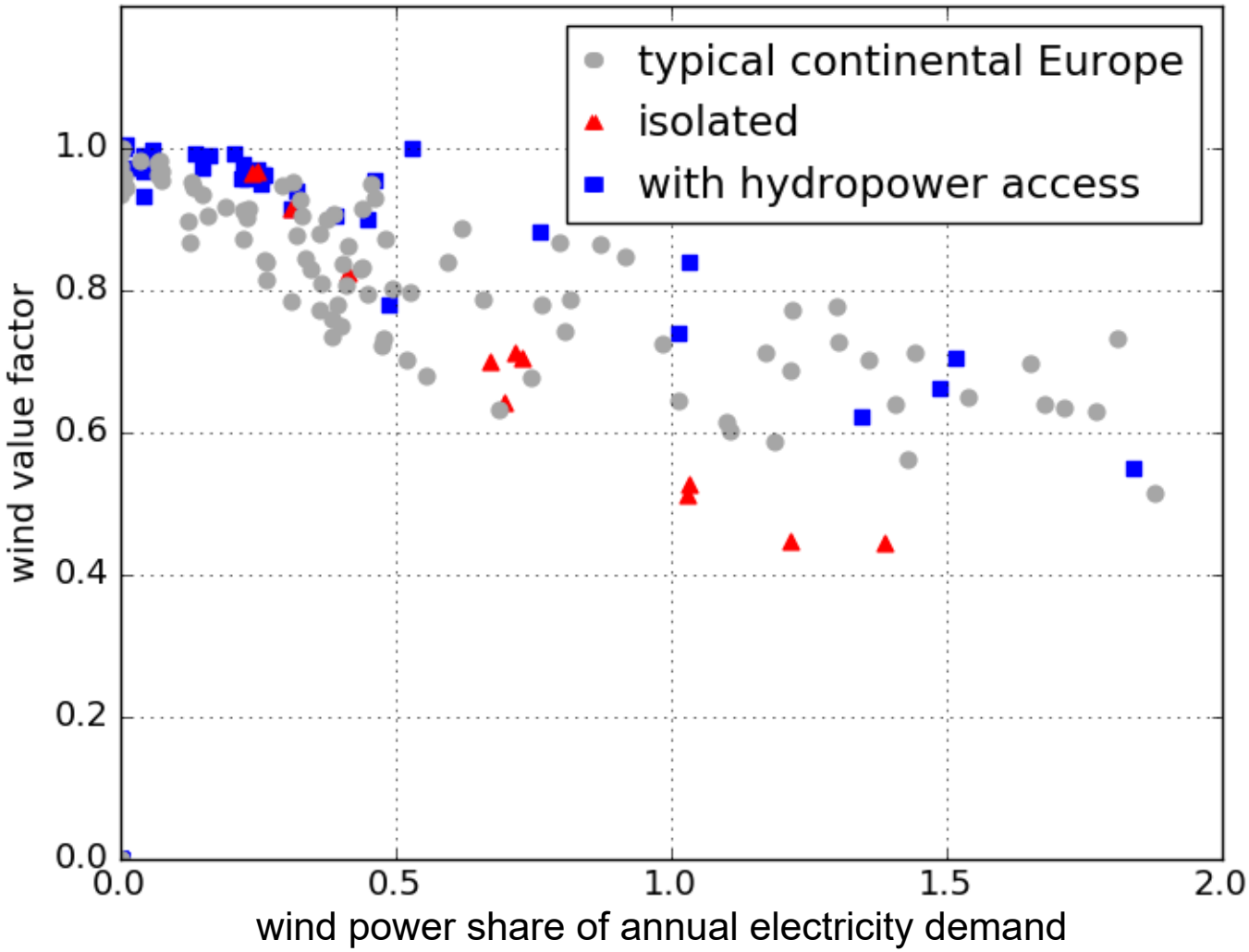


Göransson, L., Johnsson, F. (submitted)

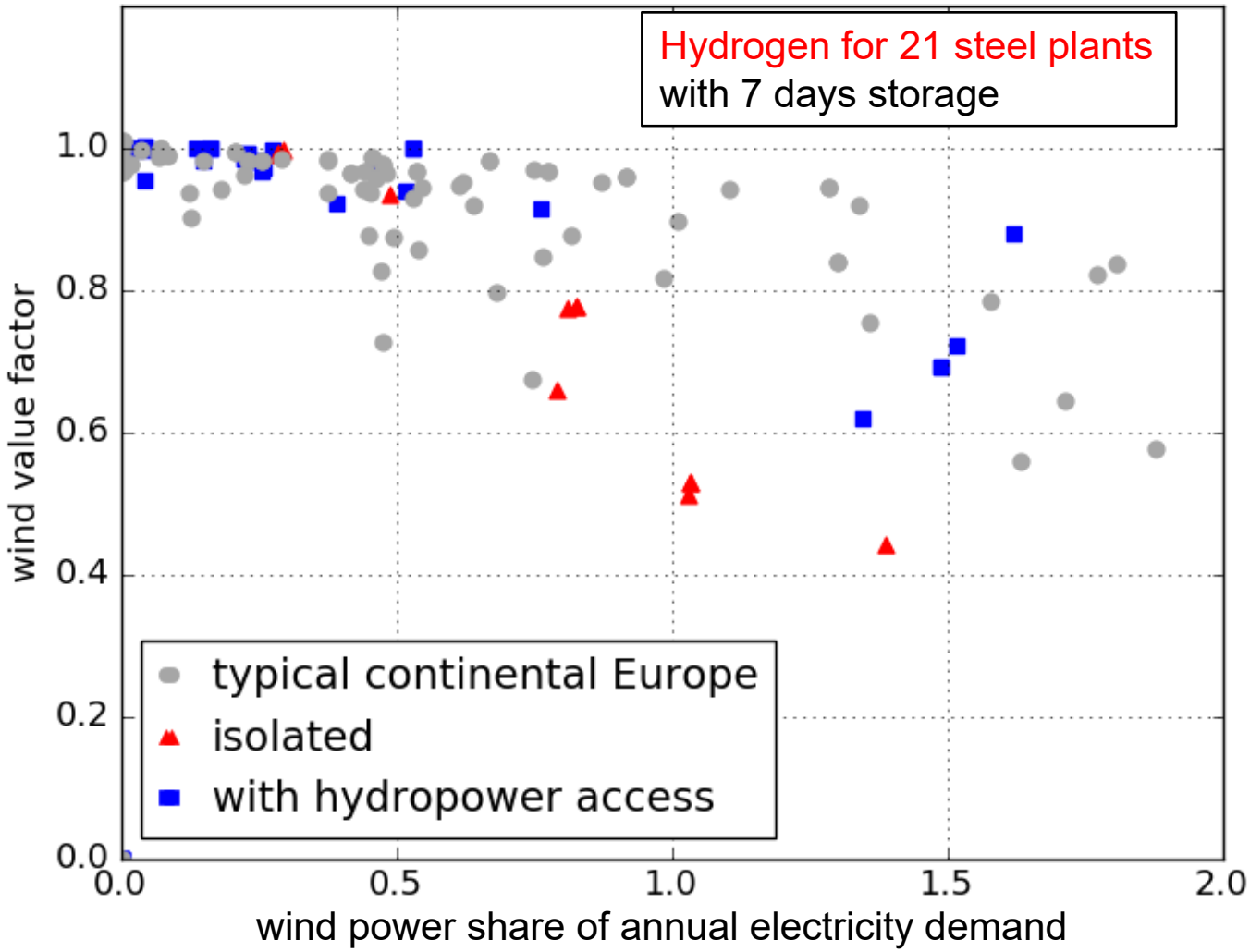
The value of wind power –without variation management



The **value factor** (0-1): ratio of the production weighted marginal cost of electricity to the time-weighted average

Göransson, L., Johnsson, F. (forthcoming)

The value of wind power – with variation management



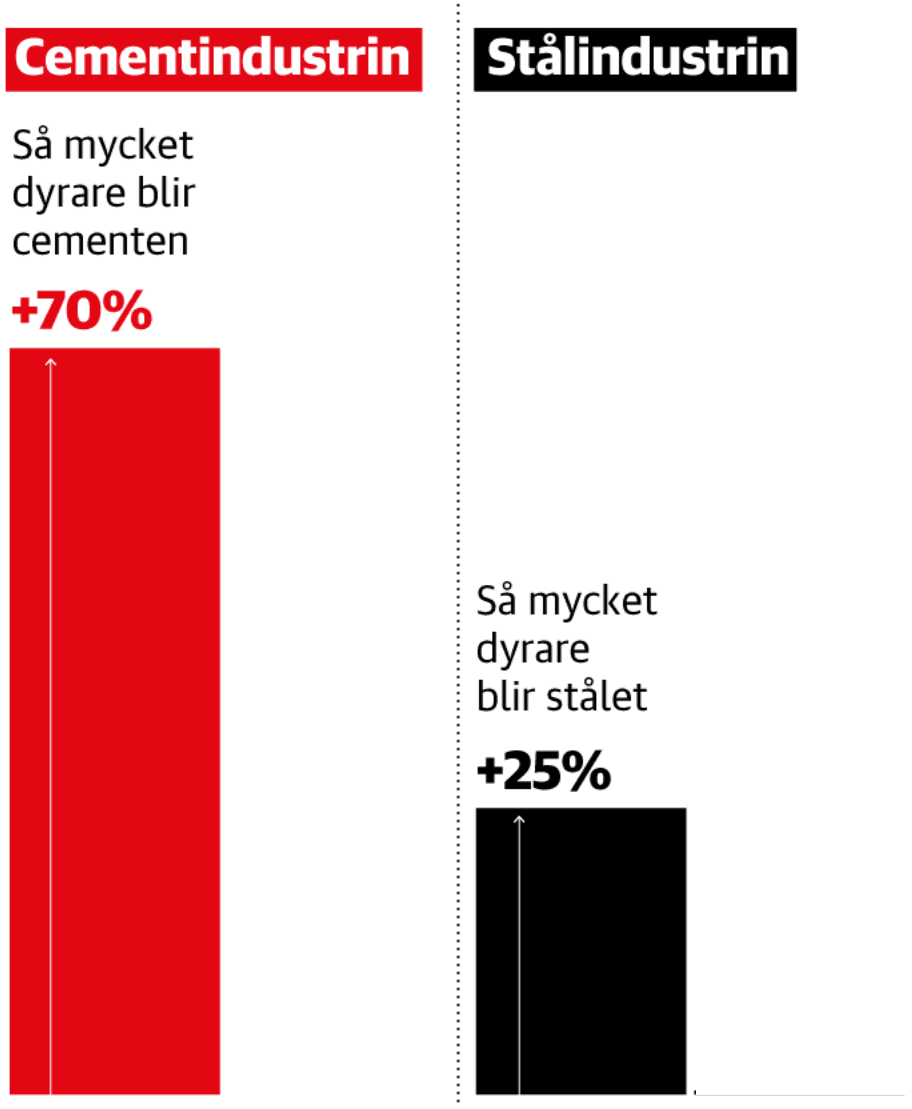
The **value factor** (0-1): ratio of the production weighted marginal cost of electricity to the time-weighted average

Göransson, L., Johnsson, F. (forthcoming)

“Green” Pricing - Consumer side

Nordisk basindustri
Åtgärder för att uppfylla långsiktiga utsläppsmål kostar ~100€/ton CO_2

Handel med utsläppsrätter
EU-ETS < 10 €/ton CO_2

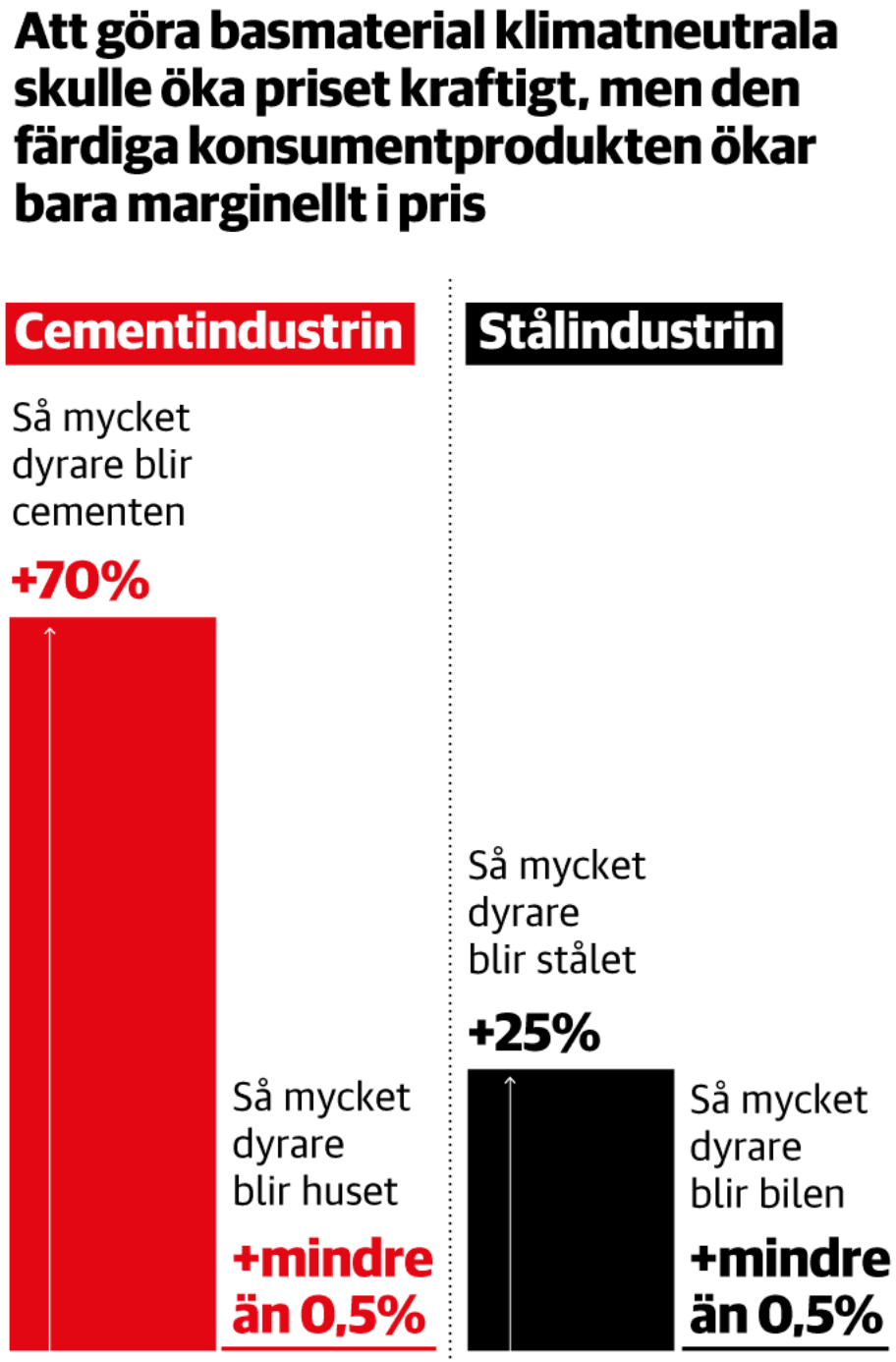


Nya sätt att prissätta koldioxid behövs

Nordisk basindustri
Åtgärder för att uppfylla långsiktiga utsläppsmål kostar ~100€/ton CO_2

EU-ETS < 10 €/ton CO_2

Rootzén and Johnsson, (2015)
Se
http://www.dn.se/debatt/plan-saknas-for-att-minska-basindustrins-klimatpaverkan/

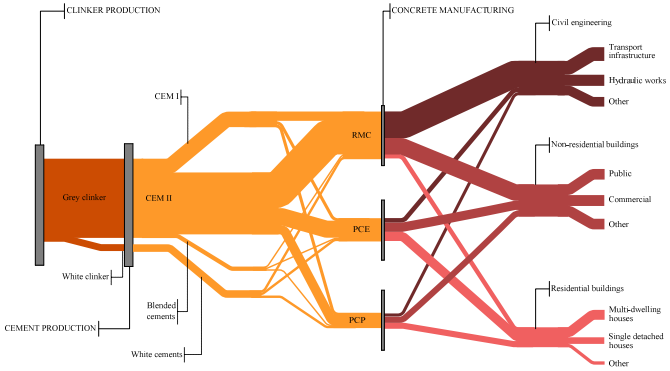


Indicators (KPI)

- **Global trends**
  - Enormous challenge to ramp up RES and reduce fossil fuel use
    Fossil-fuel strategies are required!

- **Economy and Security of Supply**
  - Enough sites for thermal plants peak power sites may be a challenge

- **Cross-sectoral integration**
  - Can increase value of wind (and VRE)



- **“Green” Pricing - Consumer side**
  - EU-ETS will not impose investments in transformative measures
    Yet, small price increase if allocating cost for these measures to consumer side

Varför ta ledningen i klimatarbetet?

- Om världen rör sig i enlighet med Parisavtalet – att **begränsa** jordens uppvärmning till väl under **2ºC**

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- Om världen rör sig i enlighet med Parisavtalet – att **begränsa** jordens uppvärmning till väl under **2ºC**

  ⇒ Mycket stor efterfrågan på **koldioxidneutrala produkter** och **tjänster**